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Efficiency Test of IRRI Fertilizing Recommendations on Rainfed Low Land Rice Field in West Kalimantan

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ABSTRACT

Fertilizing recommendation for lowland rice field in West Kalimantan is still in national scale and tends to be excessive. It is less relevant due to various factors such as the test method competence, the carrying capacity of the land, and the diverse condition of rice field agro-ecosystem. Site-specific nutrient management (SSNM) is an approach for rice fertilizing on paddy plot based on science, history of land fertilization, and nutrient sources surrounding the area which can affect soil fertility level and soil conservation.This study was aimed to examine fertilizing efficiency of N, P, and K and the increased productivity of rice by utilizing software (website) of the IRRI. The study was conducted in farmers fields in two villages, *i.e.* Anjongan and Pak Bulu, Pontianak Regency, West Kalimantan. The results showed that the SSNM fertilization on rice increased yields by the average of 0.62 t ha^{-1} (13.47%) per growing season. The efficiency of SSNM fertilization was on the average of 22.05% N, 48.25% P_2O_5, and 31.50% K_2O. The additional profits obtained from the SSNM recommendation was on the average of IDR 1,886,317 per ha pergrowing season compared to the profits from the FFP (farmer fertilizer practice).

Keywords: Fertilizing efficiency, low land, rice, site specific fertilization

INTRODUCTION

Determination of rice fertilizer dosage recommendations at the national level is considered to be no longer relevant as guidelines for fertilizing rice fields in several regions in Indonesia (Adnyana. 2011). The diversity of soil fertility conditions and site specific environment in some areas, causing the need for balanced fertilization based on site specific conditions and the fertilizer recommendation given is not to be the same in every region (Suryana 2004; Haefele *et al.* 2010).In some areas of intensification, frequent fertilization lead to the imbalance of nutrients in the soil, damaged to soil properties, environmental pollution and lost of farmer profits (Xu *et al.* 2009; Pampolino *et al.* 2012). Excessive fertilization which was not appropriate in dosage, time, and way could cause the plants grow un-optimally, either because of nutrient deficiencies or excessive fertilization (Dobermann and Fairhurst 2000; Buckley and Carney 2013).

Recommended dose of fertilizer for rice is influenced by various factors such as the kind of the test method, the carrying capacity of the land, and the crop needs on various nutrients (Setyorini *et al.* 2006). There have been many test methods to determine the efficiency of rice fertilization, such as the use of leaf color chart in rice that can save N fertilizer (Wahid 2003). The site specific nutrient management (SSNM) fertilization is a soil nutrient balance-based fertilization technology which uses a rational, efficient fertilization based on the plant needs and according to their variation in time and space (Dobermann 2003; Dobermann *et al.* 2004; Pasuquin *et al.* 2014). The SSNM is a computer-based guidelines developed by the International Rice Research Institute (IRRI) in collaboration with the Agency for Agricultural Research and Development (IAARD) through the institutions under its aegis such as the Assessment Institute for Agricultural Technology (AIAT) in every province in Indonesia.

The SSNM is a fertilization technology with a method that requires an answer to a question by using the internet applications that can be accessed through *http://webapps.irri.org/nm/id.* At the same time, approaches must be relatively simple with minimal characterization or interviewing of farmers for each field in order to ensure rapid, cost effective delivery of field-specific guidelines to millions of small-scale farmers (Buresh *et al.* 2007). The answers on some questions that can be easily understood by farmers, such as rice field specifications and history of rice farming management practiced by the farmers which start from land preparation, use of inputs such as seed and fertilizer to harvesting and post-harvest handling, then calculated and can be made rice fertilization recommendation on site specific (Witt and De Datta 1989; Mutert and Fairhurst 2002; Fairhurst *et al.* 2007). Therefore, the presentation of the SSNM principles needs to be simplified and adjusted with the local way in order to be easily applied by extension workers and farmers and then to be developed on local land condition and rice crop (Janssen *et al.* 1990).

This SSNM technology needs to be tested in every area in accordance with the nature and diversity of rice fields characteristics and rice farmers characteristics in each region in Indonesia, including in Pontianak Regency, West Kalimantan Province. Pontianak Regency is one of the rice production centers in West Kalimantan, especially in Anjongan Sub-district. Most of the rice fields in Pontianak Regency are in rainfed areas in which the irrigation sources depend on rainfall and in some locations the irrigation sources come from the mountain. The rice yields in those areas were still relatively low in the average of 2-3 tons per hectare.

The farmers habits in those region are transplanting with more than 20 days seedlings, burning rice straw and not returning the residue of the harvested rice straw to the rice fields, applying simple fertilizer based on the ability of farmers to buy fertilizer. Yet for the developed farmers, fertilization rates are in a high dose such as, for urea ranges from 300-400 kg ha^{-1}. This is wasteful and can cause soil contamination problems if it is done continuously. The SSNM is conducted with a hope to be able to increase the fertilization efficiency, profitability and rice yields in rainfed lowland rice for average climatic conditions (Wang *et al.* 2007; Sapkota *et al.* 2014). The SSNM-based fertilizer efficiency test in the field can be used to evaluate the fertilizer recommendation for rice fields in various rice producing areas in Indonesia. The SSNM scientific principles for optimally supplying crops with nutrients and local way in order to be easily applied by extension workers and farmers, and then to be developed on local land conditions and rice crops (local specific) (Fageria and Virupax 1999; Timsina *et al.* 2010).

Farmers, agricultural extension workers, and researchers are involved in the efficiency test of fertilization, in which the determination and implementation of the recommendations are conducted through group discussions. Farmers in the selected fields can work altogether on the work plan that has been agreed. With this efficiency test of fertilization, the recommended fertilizer based on the SSNM principles of IRRI can be analyzed with agronomic perspective. The purpose of this study was to test the fertilization efficiency of rice based on the SSNM recommendation of IRRI and then compared to the practices and habits of FFP in West Kalimantan.

MATERIALS AND METHODS

Efficiency test of the SSNM fertilization was conducted on rainfed land owned by farmers in two villages, *i.e.* AnjonganVillage and Pak Bulu Village, Anjongan Sub-district, Pontianak Regency, West Kalimantan Province. This study was carried out in May to December 2012.

Material used in this study were rice seed, fertilizers, *i.e.* urea, KCl, and NPK compound fertilizers and pesticides, stationery, and gauges crops. Fertilization recommendations were based on the principles of SSNM compared to the FFP recommendations on the same land conditions. This field test was conducted by involving farmers in which the determination and implementation of the recommendations through discussions with farmer groups, extension workers, and researchers from the AIAT.

The study was conducted in rainfed land owned by farmers in the two villages involving 40 farmers which have the land area of 300 m^2 to 1000 m^2. The determination of SSNM fertilizer dose was based on the fertilizer dose recommendation of IRRI, which was conducted by interviewing each selected farmer to fill the questionnaire from IRRI website (*http://webapps.irri.org/nm/id*). Based on the results of SSNM fertilizer recommendations through that internet access, the fertilization period was applied in three times, i.e. in the early period (0-14 days after planting), active tillering, and at the time of primordia (panicle initiation) (Table 1). While the dose of fertilizer by FFP was applied in two periods of fertilization (Table 2).

Each farmer managed both two study plots (SSNM and FFP plots) uniformly.Tillage, rice varieties, planting, fertilization, pest and disease control, harvesting and post-harvest handling were treated in the same way for both plots (SSNM and FFP). Fertilizers used for SSNM and FFP were bought from the same source.

Determination of crop yieldswas made when the rice crop physiologically mature. All clumps in the sample plot size of 2 x 5 m were harvested in three plots from the two plot treatments (SSNM and FFP). Then, the weight of dry grain harvest of the SSNM and FFP treatments were measured in kg. Then each dry grain yields were determined at 14% moisture content, calculated by correcting the dry grain yields of SSNM and FFP plots at 14%

Table 1. Calculation of fertilizer rates for field plot with nutrient management treatment.

No	Farmer's name	Location (village)	Field size (m^2)	Calculate the N, P_2O_5, and K_2O rates for each date of application											
				Early			Active tillering			Panicle initiation			Total		
				($kgha^{-1}$)											
				N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
1	Sukiman	Anjongan	462	45	45	45	46	0	0	46	0	0	137	45	45
2	Supangat		360	30	30	30	46	0	0	46	0	0	122	30	30
3	Poniran		322	30	30	30	46	0	0	46	0	0	122	30	30
4	Rukimin		396	30	30	30	46	0	0	46	0	0	122	30	30
5	Sigit		420	28	28	28	43	0	0	58	0	0	128	28	28
6	Jamal		573	30	30	30	46	0	0	46	0	0	122	30	30
7	Wardoyo		490	23	23	23	32	0	0	46	0	0	101	23	23
8	Helma		435	28	28	28	38	0	0	39	0	0	105	28	28
9	Jais		420	60	60	60	42	0	0	44	0	0	146	60	60
10	Rebo		442	30	30	30	46	0	0	46	0	0	122	30	30
11	Supit		325	38	38	38	38	0	0	38	0	0	114	38	38
12	Wiji		420	30	30	30	42	0	0	44	0	0	116	30	30
13	Tamiran		432	38	38	38	51	0	0	55	0	0	143	38	38
14	Tarudin		420	30	30	30	42	0	0	44	0	0	116	30	30
15	Panijan		456	25	25	25	38	0	0	38	0	0	102	25	25
16	Muin		684	28	28	28	39	0	0	39	0	0	106	28	28
17	Gondo		600	19	19	19	26	0	0	26	0	0	72	19	19
18	Musriadi		308	30	30	30	31	0	0	37	0	0	98	30	30
19	Tarmuji		530	30	30	30	31	0	0	37	0	0	98	30	30
20	Sumarji		539	23	23	23	29	0	0	30	0	0	82	23	23
21	Mariana	Pak Bulu	402	7	30	7	32	0	0	32	0	0	71	30	7
22	Jumiati		490	30	30	30	29	0	0	37	0	0	96	30	30
23	Alinus		360	30	30	30	22	0	0	26	0	0	78	30	30
24	Lusiana		420	25	25	25	9	0	0	31	0	0	65	25	25
25	Tuti		356	22	13	13	26	0	0	26	0	0	75	13	13
26	Suparman		336	25	25	25	21	0	0	26	0	0	73	25	25
27	Margareta		360	21	21	21	9	0	0	29	0	0	60	21	21
28	Cica		369	30	30	30	39	0	0	44	0	0	113	30	30
29	Marselina		375	23	23	23	10	0	0	30	0	0	63	23	23
30	Raana		450	23	23	23	24	0	0	26	0	0	72	23	23
31	Viana		430	19	10	10	32	0	0	32	0	0	83	10	10
32	Darem		767	34	11	11	23	0	0	35	0	0	92	11	11
33	Sumiati		560	38	38	38	46	0	0	46	0	0	130	38	38
34	Kristina		840	35	30	0	48	0	0	48	0	0	131	30	0
35	Pendi		520	20	20	0	26	0	0	26	0	0	72	20	0
36	Sumiyati		460	11	17	0	26	0	0	21	0	0	58	17	0
37	Mulia		360	21	16	16	33	0	0	33	0	0	87	16	16
38	Musa		520	23	23	23	20	0	0	22	0	0	65	23	23
39	Una		480	31	31	31	27	0	0	38	0	0	96	31	31
40	Fransiska		420	9	16	0	32	0	0	5	0	0	46	16	0

moisture content. The yields were converted in t ha^{-1}. Data analysis of rice yields from the SSNM fertilization was compared to the FFP, so it could be seen how much the efficiency of fertilization based on SSNM.

RESULTS AND DISCUSSION

Fertilization is an effort to increase the availability of nutrients in order to meet the needs of plants. SSNM in aimed at dynamic field-specific

Table 2. Calculation of fertilizer rates for field plot with farmers fertilizer practice treatment.

No	Farmer's name	Location (village)	Field size (m^2)	Calculate the N, P_2O_5, and K_2O rates for each date of application (kgha^{-1})											
				Basal			Second application			Third application			Total		
				N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
1	Sukiman	Anjongan	4538	61	51	15	0	0	0	46	0	0	107	51	15
2	Supangat		4640	30	102	30	0	0	0	92	0	0	122	102	30
3	Poniran		4678	76	30	30	0	0	0	46	0	0	122	30	30
4	Rukimin		7010	61	48	0	0	0	0	61	0	0	123	48	0
5	Sigit		3580	29	90	0	0	0	0	29	0	0	58	90	0
6	Jamal		4316	92	36	0	0	0	0	46	0	0	138	36	0
7	Wardoyo		4427	92	72	0	0	0	0	46	0	0	138	72	0
8	Helma		3565	19	41	19	0	0	0	58	0	0	76	41	19
9	Jais		2080	122	30	30	0	0	0	92	0	0	214	30	30
10	Rebo		4580	60	96	60	0	0	0	0	0	0	60	96	60
11	Supit		5675	50	110	50	0	0	0	38	0	0	88	110	50
12	Wiji		2080	60	96	60	0	0	0	46	0	0	106	96	60
13	Tamiran		1568	58	90	0	0	0	0	58	0	0	115	90	0
14	Tarudin		2068	122	102	30	0	0	0	92	0	0	214	102	30
15	Panijan		5400	127	50	50	0	0	0	77	0	0	203	50	50
16	Muin		1544	115	90	0	0	0	0	58	0	0	173	90	0
17	Gondo		3692	76	64	19	0	0	0	58	0	0	134	64	19
18	Musriadi		1961	30	102	30	0	0	0	92	0	0	122	102	30
19	Tarmuji		1970	30	102	30	0	0	0	92	0	0	122	102	30
20	Sumarji		4604	99	102	30	0	0	0	46	0	0	145	102	30
21	Mariana	Pak Bulu	2080	68	45	45	0	0	0	23	0	0	91	45	45
22	Jumiati		2020	106	60	60	0	0	0	46	0	0	152	60	60
23	Alinus		1733	106	60	60	0	0	0	46	0	0	152	60	60
24	Lusiana		2480	63	25	25	0	0	0	38	0	0	102	25	25
25	Tuti		5550	38	19	19	0	0	0	19	0	0	57	19	19
26	Suparman		2580	127	50	50	0	0	0	77	0	0	203	50	50
27	Margareta		2040	76	30	30	0	0	0	46	0	0	122	30	30
28	Cica		2144	76	30	30	0	0	0	46	0	0	122	30	30
29	Marselina		4625	69	23	23	0	0	0	46	0	0	115	23	23
30	Raana		4631	91	45	45	0	0	0	46	0	0	137	45	45
31	Viana		1480	95	38	38	0	0	0	58	0	0	153	38	38
32	Darem		9640	46	23	23	0	0	0	23	0	0	69	23	23
33	Sumiati		4570	38	15	15	0	0	0	23	0	0	61	15	15
34	Kristina		2140	152	60	60	0	0	0	46	0	0	198	60	60
35	Pendi		5640	63	25	25	0	0	0	38	0	0	102	25	25
36	Sumiyati		2160	63	25	25	0	0	0	38	0	0	102	25	25
37	Mulia		6440	54	73	21	0	0	0	33	0	0	87	73	21
38	Musa		4664	76	30	30	0	0	0	46	0	0	122	30	30
39	Una		5598	63	25	25	0	0	0	38	0	0	102	25	25
40	Fransiska		1580	95	38	38	0	0	0	58	0	0	153	38	38

management of N, P, and K fertilizer to optimize the balance between supply and demand of nutrients. The plant needs for N, P, or K fertilizer are determined from the gap between the supplies of a nutrient from indigenous sources (Wang *et al.* 2007). Derived from SSNM fertilizer recommendations calculation, the fertilization period was applied in three times with the highest dose of N, P and K were 146, 60 and 60 kg ha^{-1} respectively (Table 1). At the same time, as the dose of fertilizer by FFP gave in two periods of fertilization with the highest dose of N, P and K were 214, 110 and 60 kg ha^{-1} (Table 2).

It is quite likely that applying fertilizer N at rates and times to better match the dynamic needs of the rice plant, as practiced with SSNM, can lead to reduced losses of fertilizer N as gases including N_2O (Pampolino *et al.* 2007). Fertilizer N applied to submerged rice soils is prone to large losses through mechanisms as ammonia volatilization and nitrification–denitrification (Buresh *et al.* 2006). Nitrous oxide, a greenhouse gas, is one of the end products of nitrification–denitrification. More effective nutrient management through SSNM can enhance the fertilizer use efficiency leading to more grain yield per unit of fertilizer. This can avoid accumulation of inorganic nutrient in periods when crop demand for added nutrient is low, such as at the end of the rice-growing season.

Grain Yields

Dry grain yields of 14% moisture content from 40 farmers in which each farmer fertilizes on plot based on SSNM and FFP in AnjonganVillage and Pak Bulu Village are shown in Figure 1.

Figure 1 showed that the fertilization recommendation from IRRI (SSNM) in Anjongan and Pak Bulu Villages had greater dry grain yields (moisture content of 14%) than that of FFP fertilization. The average of dry grain yields (moisture content of 14%) on the SSNM fertilization treatment were 4.93 t ha^{-1} and 4.42 t ha^{-1}, for Anjongan and Pak Bulu respectively, whereas the FFP were only 4.36 t ha^{-1} and 3.75 t ha^{-1} (Figure 2). This showed that the fertilization treatment based on site specific nutrient fertilization (SSNM) was proven to have

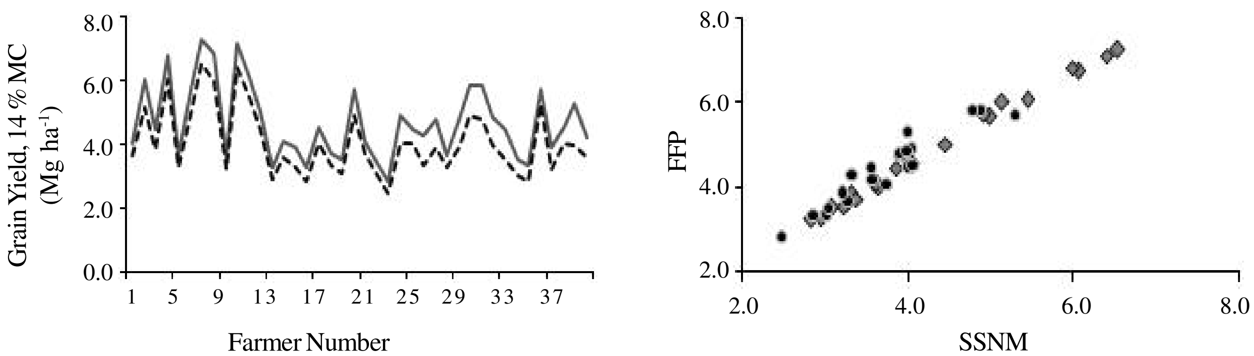

Figure 1. Grain yields from 40 farmers in AnjonganVillage (◆) and Pak Bulu Village (•) based on SSNM (▬) and FFP (▪▪) fertilization recommendation.

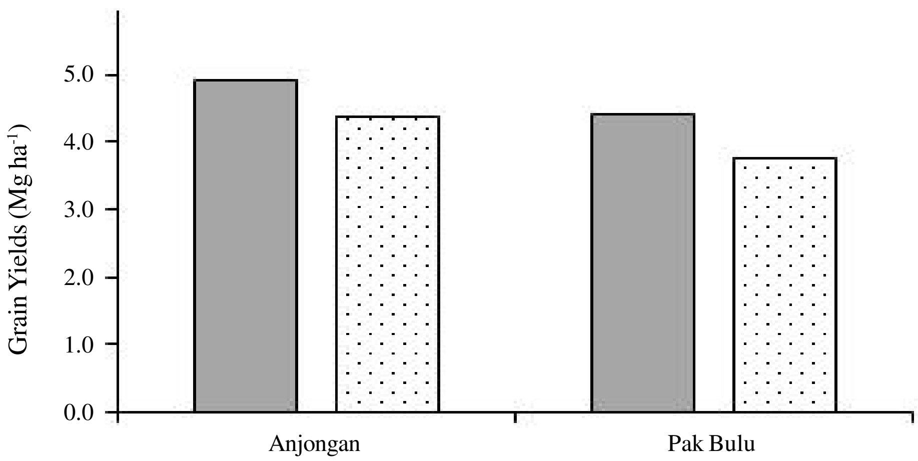

Figure 2. The average of grain yields on SSNM (▦) and FFP (□) in AnjonganVillage and Pak Bulu Village

the higher grain yields than the FFP. This agreed with the study of Li *et al*. (2012) who conducted a research in Jiangsu Province of China to incorporate SSNM into local rice management system in a wheat – rice rotation. They increased rice grain yield by 30% over local FFP, but saved only about 5% N fertilizer. In a more recent study also conducted in Jiangsu Province of China, Xue *et al*. (2013) developed an improved rice management system combining both SSNM and FFP. Compared with local FFP, SSNM increased rice yield and agronomic N use efficiency by 14.4% and 64.1%, respectively.

Fertilization based on the SSNM recommendation with a lower dose and three periods of fertilization, i.e. in the early planting (0-14 days after planting), in the active tillering of rice plants, and at the time of primordia (panicle initiation), was able to produce more grain yields compared to the FFP fertilization which only applied two periods of fertilization, i.e. in the basis fertilization (basal) and at the time of primordia (panicle initiation).

Fertilization Efficiency

Results of fertilization efficiency on N, P_2O_5, and K_2O on SSNM and FFP fertilization in AnjonganVillage and Pak Bulu Village can be seen in Table 3.

Table 3 showed that there was N fertilizer efficiency both in AnjonganVillage and Pak Bulu

Table 3. Efficiency of fertilization and profits on SSNM compared to FFP fertilization recommendation.

Village	Total of farmers	Grain yield, 14% MC (Mg ha^{-1})		N (kg ha^{-1})		P_2O_5 (kg ha^{-1})		K_2O (kg ha^{-1})		Net benefit (Rp)
		SSNM	FFP	SSNM	FFP	SSNM	FFP	SSNM	FFP	
Anjongan	20	4.93	4.36	114	129	31	75	31	24	1.556.277
Pak Bulu	20	4.42	3.75	81	120	23	37	18	34	2.216.357
Pontianak District	40	4.67	4.05	98	124	27	56	24	29	2.599.469

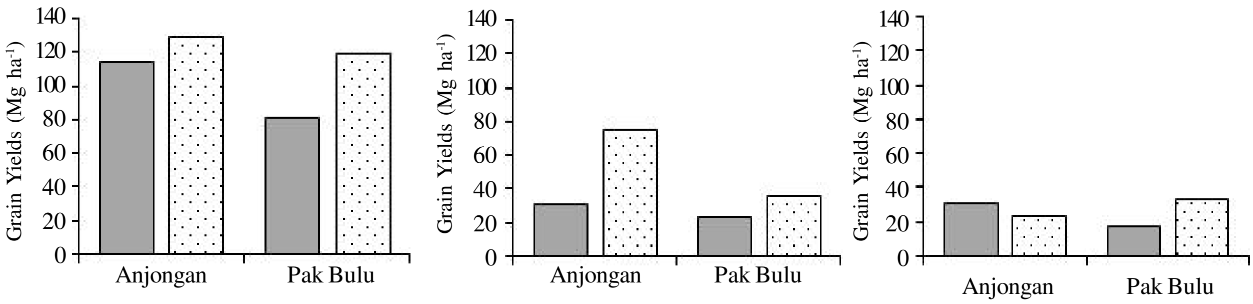

Figure 3. The average for efficiency of N, P_2O_5 and K_2O fertilization on the SSNM (■) and the FFP (□) in AnjonganVillage and Pak Bulu Village.

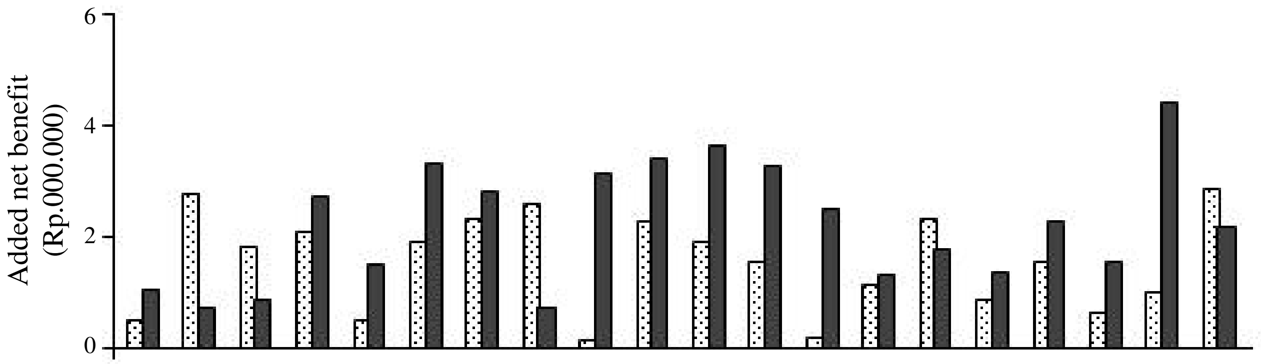

Figure 4. Additional profit of the SSNM fertilization in Anjongan Village (□) and Pak Bulu Village (■).

Village. The SSNM fertilization in those two locations could save N fertilizer at 15 kg ha^{-1} (11.6%) and 39 kg ha^{-1} (32.5%), respectively, when compared to FFP fertilization.This agrees with research done by Pasuquin *et al.* (2014) who found SSNM had a significantly higher N use efficiency compared to the FFP. Average efficiency of N under SSNM was 27 kg kg^{-1}compared to 19 kg kg^{-1} in the FFP in the same season, which was an increase of 42% relative to the FFP. In rice fields Zhejiang

Table 4. Calculation of profits at the SSNM fertilization recommendation.

No	Farmer's name	Location (village)	SSNM		FFP		Additional net profit for SSNM (IDR)
			Total value of rice (IDR)	Total cost of fertilizer used (IDR kg^{-1})	Total value of rice (IDR)	Total cost of fertilizer used (IDR kg^{-1})	
1	Sukiman	Anjongan	14,867,584	1,200,000	13,485,597	340,000	521,987
2	Supangat		22,283,064	940,000	19,020,295	470,000	2,792,769
3	Poniran		16,539,330	940,000	14,253,433	470,000	1,815,897
4	Rukimin		25,059,756	940,000	22,436,255	420,000	2,103,501
5	Sigit		13,414,513	944,250	12,075,567	105,000	499,697
6	Jamal		21,038,111	940,000	18,501,893	315,000	1,911,218
7	Wardoyo		26,959,634	747,000	24,188,348	315,000	2,339,286
8	Helma		25,345,430	839,250	22,142,836	235,000	2,598,344
9	Jais		13,155,823	1,434,800	11,923,981	340,000	137,042
10	Rebo		26,407,816	940,000	23,699,647	520,000	2,288,169
11	Supit		22,457,692	1,000,000	20,143,947	625,000	1,938,745
12	Wiji		18,599,676	914,800	16,454,818	312,500	1,542,558
13	Tamiran		12,091,686	1,133,000	10,888,110	105,000	175,576
14	Tarudin		15,105,695	914,800	13,374,869	340,000	1,156,026
15	Panijan		14,446,349	783,333	12,260,653	940,000	2,342,363
16	Muin		12,017,600	838,000	10,484,222	157,500	852,878
17	Gondo		16,790,170	566,500	15,000,202	340,000	1,563,468
18	Musriadi		13,760,521	830,800	12,501,009	235,000	663,712
19	Tarmuji		12,985,073	830,800	11,382,089	235,000	1,007,183
20	Sumarji		21,192,636	663,000	18,177,010	522,500	2,875,126
21	Mariana	Pak Bulu	14,987,409	574,800	13,866,582	495,000	1,041,028
22	Jumiati		12,374,033	822,400	11,193,360	365,000	723,273
23	Alinus		10,383,519	738,400	9,162,075	365,000	848,045
24	Lusiana		18,116,921	615,333	15,007,516	235,000	2,729,072
25	Tuti		16,558,002	500,167	14,855,113	300,000	1,502,722
26	Suparman		15,814,732	650,333	12,306,200	470,000	3,328,199
27	Margareta		17,586,014	540,400	14,482,460	235,000	2,798,154
28	Cica		13,516,243	898,000	12,123,208	235,000	730,036
29	Marselina		17,734,172	574,800	14,420,822	405,000	3,143,550
30	Raana		21,475,747	616,800	18,069,940	600,000	3,389,007
31	Viana		21,569,781	505,000	17,686,860	235,000	3,612,921
32	Darem		17,960,919	562,500	14,757,852	600,000	3,240,567
33	Sumiati		16,493,080	1,070,000	13,152,467	235,000	2,505,612
34	Kristina		12,962,678	814,800	11,268,192	417,500	1,297,185
35	Pendi		12,317,271	472,000	10,577,009	470,000	1,738,262
36	Sumiyati		21,136,867	387,333	19,646,197	235,000	1,338,336
37	Mulia		14,286,102	602,571	11,890,079	470,000	2,263,451
38	Musa		16,694,457	583,200	15,046,953	470,000	1,534,304
39	Una		19,572,297	839,167	14,789,072	470,000	4,414,059
40	Fransiska		15,474,260	327,000	13,232,907	235,000	2,149,354

China, SSNM increased N fertilizer efficiency more than 50% while fertilizer N was reduced by about 30% (Wang *et al*. 2007).

Similarly, the efficiency of P_2O_5 fertilizer was also at 44 kg ha^{-1} (58.7%) in Anjongan Village and 14 kg ha^{-1} (37.8%) in Pak Bulu Village. However, there was no savings on K_2O fertilizer of the SSNM fertilization recommendations in Anjongan Village. This was likely due to farmers habits who did not return the residue of harvested rice straw to the rice fields. The residue of harvested rice straw from grain threshing with a thresher was just stacked on the edge of rice fields and burned, so that the source of K was not utilized. Location of irrigation water sources which was far enough from rice fields and drought were also possible causes that made K_2O fertilization on SSNM was higher than the FFP. It did not happen in the locations of Pak Bulu Village that the rice fields were close to irrigation sources and the residues of harvested rice straw were returned to the rice fields, so in that location it could save K_2O fertilizer at 16 kg ha^{-1} (47.1%) (Figure 3).

Additional Net Profit

The additional net profits of the SSNM fertilization recommendation was to wards the FFP fertilization in Anjongan Village and Pak Bulu Village (Figure 4).

Figure 4 showed that the additional net profit in Pak Bulu Village was higher than Anjongan Village. This was due the fact that the N, P_2O_5 and K_2O fertilizations in Pak Bulu Village were more efficient than in the Anjongan Village (Table 3). The additional net profit of the SSNM fertilization recommendation towards the FFP fertilization for Anjongan Village was in the average of IDR. 1,556,277 and Pak Bulu Village was IDR 2,216,357 (Table 4).Pampolino *et al*. (2007) reported that the added net annual benefit due to use of SSNM was 34 US\$ ha^{-1} $year^{-1}$ in Vietnam,106 US\$ ha^{-1} $year^{-1}$ in the Philippines, and 168 US\$ ha^{-1} $year^{-1}$ in India. The increased benefit with SSNM was attributed to increased yield rather than reduced costs of inputs.

CONCLUSIONS

Site-specific nutrient management (SSNM) fertilization based on the IRRI recommendation was able to increasing rice productivity by the average of additional increase of 0.62 t ha^{-1} (13.47%) per growing season. The SSNM fertilizer recommendation on rice plants was more efficient compared to the farmer's fertilization practice (FFP), saving N fertilizer in the average of 2.7 t ha^{-1} (22.05%), P_2O_5 of 2.9 t ha^{-1}(48.22%), and K_2O of 0.9 t ha^{-1}(17.89%) per season. The additional net profits from the IRRI fertilization recommendation (SSNM) compared to the FFP in Anjongan Village was about of IDR 1,556,277 andin Pak Bulu Village was IDR 2,216,357. The additional net profit of the SSNM fertilization was about of IDR 1,886,317 per growing season in Pontianak Regency, West Kalimantan Province. It is expected that in each of the Agricultural Extension Center and all farmers in West Kalimantan Province, especially in Pontianak Regency, can refer to the IRRI fertilization recommendation based on the SSNM, because it was proven to be more efficient and profitable. However, it still needs to be furthered research on the SSNM fertilization recommendation in tidal lands.

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